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Prickly-Pear Experimental
==== Station, Dulacca. ====

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Report from 1st May, 1915, to 30th June, 1916.
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BY

Dr. Jean White-Haney,

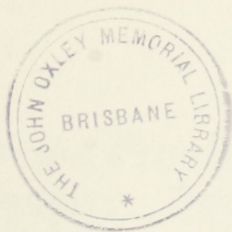
Officer in Charge.

*(Reprint of Appendix IV. of Annual Report of Department of
Public Lands for the Year 1915.)*

Anthony James Cumming, Government Printer, Brisbane.

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Report of the Officer in Charge of the Prickly-Pear Experimental Station, Dulacca, from 1st May, 1915, to 30th June, 1916.

Prickly-pear Experimental Station,
Dulacca, 30th June, 1916.

To the Chairman of the Board of Advice on Prickly-pear Destruction.

SIR,—I have the honour to submit my fourth Annual Report on the work done at the Prickly-pear Experimental Station, Dulacca, from 1st May, 1915, till 30th June, 1916.

The last fourteen months have been strenuous ones, and more particularly does this apply to the last seven months. In my previous reports I have mentioned that I believed that I had found the best pear destroying specific yet known, although my conclusions were up to that time deduced from what, in my opinion, was insufficient evidence owing to the extremely limited quantity of the specific obtainable.

About the middle of last year I was fortunate in being able to procure nearly a ton of the crude specific for the purpose of further experimental research, and since then no time has been lost in repeating my experiments on a larger scale, and with the introduction of all manner of variations. Well over 1,000 experimental plots have been treated during the poisoning season just passed. As a result, I am glad to be now in a position to state, without hesitation, that I am confident of having demonstrated the most generally effective pear-killing specific which has ever been tried.

That I am justified in drawing these conclusions will, I think, be evident from the following text:—

APPLICATION OF POISONOUS SPECIFICS TO DULACCA PRICKLY-PEAR.

MODES OF APPLICATION.

The modes of application employed at the Experimental Station during this season have been:—

1. *Injection*—

- (a) Of solid or undiluted specific in a liquid form. These are henceforth referred to for convenience as “solid injections.”
- (b) Of dissolved solids or diluted specifics. These are henceforth referred to as “liquid injections.”

2. *Spraying*—

- (a) By means of ordinary more or less coarse spray pumps.
- (b) By means of very fine atomiser spray pumps.

The evolution of poisonous gases has not been further considered here this season.

INSTRUMENTS OF APPLICATION.

Injection.—The method which has been adopted at this station, and has been found the most generally satisfactory one, is to slit open the side of the second segment from the top of a branch of pear by means of a sharp knife, which is pushed in so as to make a cavity in the segment 2 or 3 in. in depth. On the removal of the knife a measured quantity of the poison is introduced into the cavity thus formed. Care must be taken that the skin is only pierced at the orifice, otherwise leakage of liquid poisons would occur. In addition, when injecting liquid specifics the cavity must be made sufficiently large—*i.e.*, large enough to hold about half as much liquid again as has to be inserted. At the same time the orifice of the cavity must be kept open by means of a small piece of stick, or some such object, in order to prevent the expulsion of the liquid through the orifice by the closing of the cavity owing to the walls of the segment coming together again.



PLATE 1.—Spray pump, worked by one man.

Spraying.—For hand-spraying the Kirby Uneda pump was generally used. The spray material (usually in the form of a dilute solution) is poured into a bucket or kerosene tin. The foot end of the spray pump is inserted into the liquid inside the tin, where it is held firmly by means of a foot rest. (*See Plate 1.*)

This method is quick and simple, more especially in open country. The operator moves around the clump of pear spraying all around it, not omitting the large old corky trunks and stems, and to do this he must stop and spray in at least four places to each clump.

The bulk of the spray material is carried in a water cart of 100 to 200 gallons capacity, which is pulled by a horse to the nearest possible



PLATE 2.—Spray cart with spraying apparatus (slightly modified).



PLATE 3.—Atomiser worked by one man.

locality adjacent to that in which the spraying is to be done. The kerosene tin or bucket is filled from time to time from the tap in the water cart.

In open country where there is not much fallen timber, &c., the water cart may be taken through, and the spraying done by means of a pump and Meteor spraying apparatus connected with it. (*See Plate 2.*)



PLATE 4.—Atomiser worked by one man.

For fine handwork atomiser sprays have been used, and they have been found to do excellent work.

Several types of atomisers have been tried (*see* Plates 3 and 4).

CHEMICAL SPECIFICS EMPLOYED AND DETAILED RESULTS OF EXPERIMENTS.

During the present season only three chemical specifics have been used to any important extent, viz. :—

- Arsenic acid (crude).
- Arsenic trichloride.
- Arsenite of soda and salt.

The effects produced in the plants of prickly-pear poisoned with these specifics have been carefully compared in all details.

The bulk of the experiments involving the use of arsenic acid were performed with crude syrupy arsenic acid, procured from the Victor Leggo Chemical Co., Victoria.

This specific consists of a mixture of thick syrup and a greyish white paste. According to the Government Analyst of Queensland, to whom a sample was sent for analysis, the syrup contains 70.8 per cent., and the paste 74.0 per cent. of arsenic pentoxide. This will be referred to throughout this report as crude arsenic acid. The arsenic trichloride used was obtained from the Cactus Estates, Limited. The arsenite of soda and salt specific was mixed at the station from the following substances in the proportions stated:—

White arsenic trioxide	..	..	..	10 lb.
Caustic soda	..	..	..	4 „
Common salt	..	..	..	15 „

These substances were well ground up and mixed by means of a pestle and mortar. For liquid injections this quantity was made up to 8 gallons by the addition of water, and for spray, the same weight of mixture was brought up to 100 gallons with water.

The poisoning season, lasting between the middle of December and the end of April, which has just passed, cannot be regarded as in any respects a normal one. The unusual climatic conditions existing last year, and during the present one, have influenced in a marked degree the process of pear-poisoning.

One of the severest droughts which has ever been experienced on the Darling Downs (the rain registered at this station for 1915 being 11.76 inches) was followed by a rainfall of 4.74 inches in January, 1916. During the following February and March 2.02 in. and 3.34 in. were recorded respectively. April, after the first few days, proved to be extremely dry. The rapidity with which vigorous new shoots were produced by the Dulacca pear almost immediately following each down-pour was extraordinary, and the plants during the late summer and autumn were completely covered with fresh green segments, thus presenting the appearance usually exhibited in the spring. This copious production of new segments at this time of year is most unusual, and apparently is responsible, directly or indirectly, for the less degree of success which has accompanied the pear-destroying operations. It has been repeatedly stated that the utility of the spraying of poisonous specific is reduced to a minimum during the spring months. The unsuccessful attempts to kill plants by poisonous sprays in the spring is in all probability due to the increased vitality of the plants while they are putting out their new growth, and the upward direction of the sap current. This appears to me to be the only feasible explanation for the partial failure of poisonous specifics during this season. According to the usual custom adopted at this station, the poisoning experiments instigated this season were performed in Series A and B.

SERIES A.

This comprised the poisoning, throughout the season, of the pear in a large number of small plots. Where practicable two sets of plots were treated every month. The sets of plots were, as far as possible, repetitions of each other, one set being poisoned as soon as convenient after appreciable rain, during a period not exceeding fifty hours after the fall; the other set being treated after a dry spell of at least a week's duration; the work of the series extending from the middle of December, 1915, till the end of April, 1916. Each set comprised 62 plots, of which

22 were selected for solid and 22 for liquid injections, while 18 were sprayed. Each plot was carefully chosen so that the treatment extended to young and small, medium sized, and tough old plants. In this way all kinds and stages were represented. The amount of poison was administered on consideration of the approximate weight of the pear plants.

SOLID INJECTIONS.—The weight of a poison injected into each approximate hundredweight of growing pear varied in each set of plots between a maximum of 3 grams and a minimum of 0.01 gram. The weights quoted for arsenic acid or arsenic pentoxide represent the weights of the crude material mentioned near the beginning of this section. Consequently, the injections represent really a less weight of active poison than expressed by the numbers, *e.g.*, 3 grams of crude arsenic acid, containing 70.8 per cent. of arsenic pentoxide, in reality only represents 2.12 grams of that substance. The above statement applies to every quotation of arsenic acid throughout this report, unless anything to the contrary is specially mentioned. The important investigation of the season during which the operation of poisoning may be carried out with the greatest degree of success has been determined by means of special series of experiments, the result of which will be separately discussed in another section of this report.

This question, however, has also received careful consideration in the series at present under discussion.

Repeated comparison of these plots indicates that the best all-round results are furnished by those plots which were poisoned during the latter half of December. The consideration of three main investigations formed the primary basis for the method adopted in the treatment of these plots.

1. The ascertainment of the minimum quantities of poison necessary to produce satisfactory results.
2. The comparison of the three specifics mentioned previously regarding their value as pear destroyers.
3. The relative advantage gained by poison applications soon after rain has fallen over corresponding applications after a dry period of over a week's duration.

Each of these factors has received separate consideration.

The quality of the work done during January and February is only a shade inferior to that done in December, while the April plots exhibit the least degree of positive effect. The most seriously affected single plot is one poisoned in December, 2.5 grams of arsenic acid being injected per approximate hundredweight of pear. The plots which show the best results are tabulated below.

Plot.	Date Treated.	Weather preceding date of Treatment.	Specific Used.	Quantity Specific Used per approx. cwt. Pear.
2799 ..	14th December	Dry	Arsenic acid	2.5 grams.
2846 ..	10th January ..	Dry	Arsenic acid	2.0 grams.
2874 ..	23rd March ..	Dry	Arsenic acid	1.5 grams.
2872 ..	29th February ..	Wet	Arsenic acid	1.5 grams.
2858 ..	14th December	Dry	Arsenite of soda and salt	4.0 grams.

There is little to choose between six plots which rank next to the above in efficiency. These are poisoned by injections of arsenic acid, of which 3 grams, 2.5 grams, 2.0 grams, and 1.0 gram have been applied respectively per approximate hundredweight of pear.

All the plants in the plots cited above appear to be completely rotten, and have totally collapsed, and none show any signs of sprouting. The three factors referred to earlier in this section were considered in order:—

1. *Minimum quantity of poison necessary to produce good results.*—No appreciable results are produced by plants into which less than 1.0 gram crude arsenic acid, or 3 grams of arsenite of soda and salt were injected per approximate hundredweight of pear. The injection of very minute quantities of poison, though sometimes effecting good work, produces variable results. Under favourable conditions, good results may be expected from pear plants to which 2.5 grams of crude arsenic acid are allowed per approximate hundredweight of pear.

2. *Comparison of the quality of the work done by the specifics employed.*—The above table serves to show the marked superiority of the work done by arsenic acid over that done by the arsenite of soda and salt. Apart from this, this factor does not need special comment.

3. *The humidity of the atmosphere.*—In consequence of the frequent occurrence of a heavy fall of rain within a few hours of the application of the poison, much of the latter has been washed away. This naturally materially lessens the damage done to the pear in the plot, thereby rendering the comparison an unfair one. In so far, however, as it has been possible to judge, it appears that the relative humidity of the atmosphere about the time of poisoning is not of overwhelming importance in so far as the deleterious effects produced by injections of undiluted poisons are concerned.

LIQUID INJECTIONS.—On the whole, the best results shown this season by plants injected with diluted specifics are exhibited by those poisoned during January. Next in order of efficiency are plants treated in February, December, March, and April.

Particulars relating to the most affected plots after undergoing this treatment are given in the accompanying table, the pear in each of the plots mentioned being apparently completely rotted through, and in a state of collapse, with no sign of sprouts.

Plot.	Date Treated.		Weather preceding Treatment.	Specific Used.			Quantity Specific Used per approx. cwt. Pear.
3132	January, 1916	..	Dry ..	Arsenic acid (crude syrupy)			2.0 grams.
3156	February, 1916	..	ditto ..	ditto	..	..	1.5 grams.
3089	December, 1915	..	ditto ..	ditto	..	..	1.5 grams.
3130	ditto	..	ditto ..	ditto	..	..	2.0 grams.
3134	January, 1916	..	ditto ..	ditto	..	..	3.0 grams.
3152	February, 1916	..	ditto ..	ditto	..	..	0.75 grams.
3201	ditto	..	ditto ..	ditto	..	..	2.0 grams.
3222	January, 1916	..	ditto ..	ditto	..	..	0.5 grams.
3200	ditto	..	After rain	ditto	..	..	0.75 grams.

1. *Minimum dose of poison necessary.*—The results furnished by these set of plots indicate that, all conditions being favourable, successful work should ensue if the liquid be administered in such quantity that each approximate cwt. of pear may receive 2.5 grams of poison.

2. *Comparison of the quality of the work done by the specifics employed.*—As in the case of solid injections, reference to the accompanying table demonstrates that all the best results were shown by those plots which had been treated with crude arsenic acid, none of the plots treated with the other two specifics previously mentioned being represented in the list.

3. *Humidity of the atmosphere.*—The same remarks apply here as occur under the heading “Solid Injections.”

SPRAYS.—The maximum deleterious effects produced by spraying dilute specifics on to prickly-pear plants are exhibited by the plants poisoned during February. Next in order of efficiency come plants poisoned in March, December, January, and April. This series is incomplete in consequence of there not having been a sufficient number of wet days each month to permit of the fulfilment of the required conditions for the treatment of both sets of plots.

In view of the fact that Series B, which deals with the spraying of large plot areas, was treated at the first opportunity after rain, it was considered advisable for the injection plots to take precedence of the spray plots included in Series A.

1. *Minimum quantity of poison required.*—The amount of spray solution allowed per approximate cwt. of pear was universally 0.5 gallons. Though amongst the small plot series such dilute solutions as 0.01 per cent. strength were employed, it was found that in order to produce more than merely temporary superficial effects the strength of the solution should be at least 2 per cent. Better results would be assured by increasing the strength to 2.5 per cent.

2. *Comparison of the quality of the work done by the specifics employed.*—Observations of the effect of spraying solutions on to the growing pear plants emphatically confirm the statement that arsenic acid solutions produce the most permanent and most severe damage to the pear plants.

3. *Humidity of the atmosphere.*—None of the plots sprayed after a dry period of at least a week's duration exhibit any appreciable effects other than the temporary one of becoming coated with a layer of cork. The formation by the plant of this corky layer, while it actually does exercise a temporary check to growth and reproduction, is regarded as worse than useless, as it renders the segments less permeable to the action of subsequently applied poisons, thus making the plants more difficult to kill. Without exception, the effect produced by spraying under the above conditions here is evanescent. The operation of spraying, more than any of the other methods, is influenced by the relative humidity of the atmosphere. All those plants which have been sprayed with a solution of not less than 2 per cent. strength, within a few hours after a fall of at least 20 points of rain, are more or less rotten and decomposed, and show signs of collapse in some degree, unless the spraying were quickly succeeded by a further downpour, which in a great measure rendered the work done useless. It must be mentioned, however, that

in almost every instance of spraying, however complete the work accomplished may appear to be, after a varying interval of time has elapsed since the application of the poison green shoots make their appearance, issuing from some few nodes which have not received sufficient poison to permanently destroy their vitality. No poisonous specific has been used here yet which can be depended upon to completely exterminate the plants with certainty every time it is used, though in isolated plants this result is often achieved.

The experiments done here have been fairly exhaustive, every available poison of moderate cost having been tried. A spray consisting of 2.5 per cent. arsenic acid, however, if applied at a suitable time, and according to other suitable conditions specified in this report, may be depended on to reduce the plant to skin and fibre, and to such a state of collapse that it forms a crumbling mass on the ground, only a few nodes of the many thousands present on the plant being capable of the production of new shoots.



PLATE 5.—Part of plot sprayed with 2.5 per cent. solution of arsenic acid in February, 1916.
Half a gallon of solution was sprayed per approximate cwt. of pear.

Possibly some of these new shoots, later, may die off, but it appears as if the majority live and flourish and are capable of carrying on the life of the plant.

Before the production of any really vigorous growth, however, the main plant is in a condition in which it may be burnt, and thus the young shoots may be destroyed. Consequently, this production of a few young sprouts does not form an insurmountable difficulty if the remains of the decayed plants be burnt, dug in, crushed, or otherwise got rid of.

SERIES B.

This series comprised the poisoning, by means of spraying, of larger plot areas, the liquid sprayed being mostly arsenic acid solution. Three plots of areas either $\frac{1}{4}$ or $\frac{1}{8}$ of an acre were treated each month as soon as possible after rain. The strengths of solution used for these three plots were 2.5, 2.0, and 1.0 per cent., respectively.

Unfortunately, much of the work was spoilt for comparative results on account of heavy rain falling almost immediately after treatment. The following table gives a list of the plots, together with information which directly concerns them. The most affected plot is placed first, and so on in order:—

Plot.	Area of Plot.	Approximate Weight of Pear in Plot.	Gallons Poisons Used.	Solution Used.	Date Poisoned.	Last Rain Prior to Poisoning.	First Rain After Poisoning.
O.	$\frac{1}{8}$ Acres.	Cwt. 88.25	44.375	Arsenic Acid. 2.5%	29.2.16	161 points 2 days previously	35 points 7 days after
N.	$\frac{1}{8}$	109.25	54.87	2.0%	29.2.16	161 points 2 days previously	35 points 7 days after
I.	$\frac{1}{8}$	89.5	44.75	5.0%	31.12.15	36 points 3 days previously	172 points day after
R.	$\frac{1}{8}$	95.0	47.5	2.5%	9.3.16	85 points day before	140 points 5 days after
Q.	$\frac{1}{8}$	84.75	42.375	2.0%	9.3.16	85 points day before	140 points 5 days after
L.	$\frac{1}{8}$	102.5	51.25	2.5%	22.1.16	173 points night before	4 points night after
G.	$\frac{1}{4}$	245.0	122.5	2.0%	30.12.15	36 points 2 days previously	172 points 2 days after
H.	$\frac{1}{8}$	97.25	48.62	4.0%	30.12.15	36 points 2 days previously	172 points 2 days after
M.	$\frac{1}{8}$	161.5	80.75	1.0%	28.2.16	159 points day before	2 points day after
X.	$\frac{1}{8}$	109.5	54.75	2.0%	7.4.16	65 points night before	27 points during next 2 days
Y.	$\frac{1}{8}$	83.0	41.5	2.5%	8.4.16	8 points night before	19 points night after
J.	$\frac{1}{8}$	220.0	110.0	1.0%	21.1.16	23 points night before	173 points night after
P.	$\frac{1}{8}$	180.0	90.0	1.0%	9.3.16	85 points day before	140 points 5 days after
U.	$\frac{1}{8}$	86.25	43.125	1.0%	8.4.16	8 points night before	19 points night after
K.	$\frac{1}{8}$	95.5	47.75	2.0%	21.1.16	23 points night before	173 points night after

Plots O and N present exceptionally good results, and as is shown by reference to the table, the poisoning was done soon after rain. The results obtained on the plots mentioned at the bottom of the table were very poor.

Reference to the preceding table shows that those plots which were poisoned on 29th February, all things considered, give the best results, the only slight amount of damage done to the plot poisoned with 1 per cent. solution on that day being evidently due to the weakness of the solution. The best months for spraying under favourable climatic conditions, as deduced from this series of experiments, is as follows, in order of efficiency of results:—February, March, December, January, April.

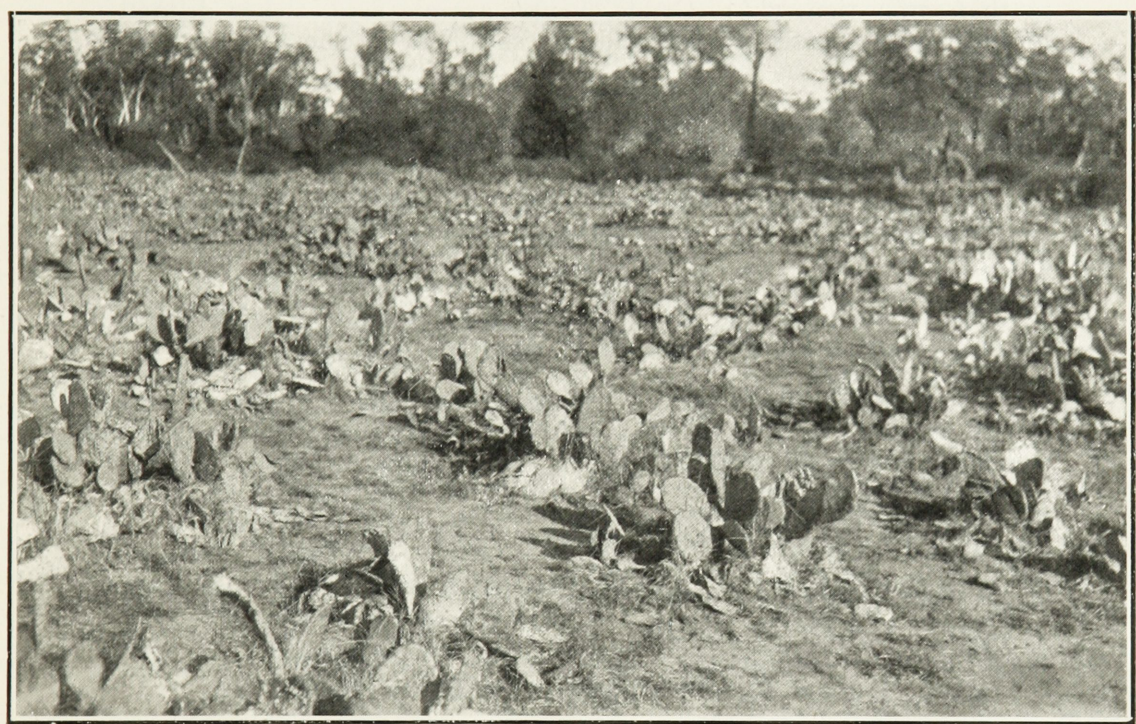


PLATE 6.—Part of plot sprayed with arsenite of soda and salt solution. Half a gallon of solution was applied per approximate cwt. of pear.

The table also is instructive in showing that heavy rain falling within a few hours of poisoning naturally decreases the value of the work done by mechanically washing the solution from the plants before the desired effect has been attained.

The superiority of the work done in February and March over that done during the other months indicates that a fall of rain occurring from five to seven days after the operation of poisoning was completed is a distinct advantage. This occurrence is, however, not worth consideration, as beyond our control. The December plots, since they were inadvertently treated with solution of double strength, cannot fairly be brought into the comparison.

The poisoning of two of the January plots was followed on the same day by a fall of 173 points of rain, which accounts for their results being far below the others in efficiency, as shown by their position low down in the list. No rainfall was recorded for a comparatively long time after the treatment of the April plots, which is probably a sufficient reason to account for their smaller degree of success.

PLOTS SPRAYED DURING 1916 WITH THE ATOMISER SPRAY.

In addition to the series of plots just discussed, some hundred plots, including those of small and of larger areas and containing different weights and sizes of pear plants, have been sprayed by means of atomisers during the present season. Only two liquid specifics have been employed in this connection, viz.:—Crude syrupy arsenic acid, either diluted or undiluted, and arsenic trichloride as supplied by the Cactus Estates, Limited.

The most thorough work has been done by a 50 per cent. solution of arsenic acid, the pear selected being especially old and corky.

In this investigation 45.8 grams or 1.61 oz. of crude arsenic acid, *i.e.*, 91.6 grams or 3.22 oz. of solution, were allowed per approximate cwt. of pear.

The actual weight of actively poisonous arsenic acid present in this quantity of crude material was 32.28 grams or 1.139 oz.

In another section it will be shown that strong solutions of arsenic acid in water form more effectual pear destroyers than do corresponding weights of the undiluted liquid.

DETERMINATION OF THE BEST TIME OF YEAR FOR THE ADMINISTRATION OF POISONOUS SPECIFICS IN PEAR DESTRUCTION.

THE BEST SEASON AND MONTH.

Experiments performed for the purpose of determining the most advantageous and also the most economical time of year for the application of poisons were amongst the first to be inaugurated here.

In general these experiments have been performed at intervals of two weeks throughout the year, each series comprising a whole year's experiments.

The information gained in this way has shown conclusively that summer and autumn are the best seasons for the application of poisons by any means. Poisoning in winter or spring, if it is to be to any extent effective, would be far too expensive a process to be practicable except, perhaps, in the case of the poisoning of more or less small plants by the method of injection or by means of the atomiser spray. The word season is taken to include temperature, actual rainfall, dryness, humidity, &c. The knowledge gained from previous series has been included in my earlier reports, and it is that obtained from the 1915 Series which is stated here. The series carried on during that year

consisted in the fortnightly poisoning, by means of different specifics and different modes of treatment, of a set of eight small plots, the treatment being accurately repeated at intervals of fourteen days during the year.

Particulars regarding the treatment of these eight plots are summarised as follows:—

Plot.	Specific Employed.	Mode of Application.	Strength of Solution.	Amount of Specific Injected per approximate cwt. of Pear.	Amount of Specific sprayed per approximate cwt. of Pear.	Amount of Vapour evolved per approximate cwt. of Pear.
1	Arsenic acid	Solid injection	Undiluted specific	3 grams.	..	..
2	Sodium arsenite and salt	Solid injection	Solid powder	3 grams.	..	..
3	Arsenic acid	Liquid injection	15.3% approx.	17 c.c.	..	..
4	Sodium arsenite and salt	Liquid injection	15.3% approx.	17 c.c.	..	..
5	Arsenious chloride	Injection	Undiluted specific	3 c.c.	..	..
6	Arsenic acid	Spray	2.5% solution	..	0.5 gallons	..
7	Sodium arsenite and salt	Spray	2.5% solution	..	0.5 gallons	..
8	Arsenious chloride	Evolution of vapour	Undiluted specific	..	..	3 ounces.

The results obtained from the 1915 Series of experiments are shown in the following table:—

Month, 1915.	Mean Maximum Temperature per Day.	Mean Minimum Temperature per Day.	Total Rainfall per Month.	Order of Efficiency of Poisonous Specifics in the Fortnightly Series of Plots.
January	92.5° F.	63.6° F.	Points, 125	Best result.
February	95.7° F.	69.4° F.	46	Fourth best result.
March	93.2° F.	64.1° F.	18	
April	84.4° F.	54.7° F.	195	Second best result.
May	70.2° F.	43.7° F.	180	Sixth best result.
June	68.8° F.	38.9° F.	35	
July	69.9° F.	40.9° F.	156	
August	70.4° F.	35.2° F.	153	Least good result.
September	84.6° F.	50.8° F.	96	
October	84.0° F.	52.5° F.	49	Fifth best result.
November	94.9° F.	59.7° F.	68	Third best result.
December	89.5° F.	64.6° F.	55	

The preceding table relates to the whole eight experiments taken collectively, which form each set of the series. As is usually the case in this class of experiments, there might be one or more exceedingly efficiently treated plots in an otherwise unsuccessful set, and *vice versa*.

On account of this probability, those plots of the whole series which had throughout the series received similar treatment were compared with each other, giving the following results:—

SOLID INJECTIONS—1915 SERIES OF EXPERIMENTS.

Specific.	Month Applied.			Degree of Efficiency Attained.
Arsenic acid	January	..	..	Most affected.
Arsenic acid	March	..	..	Second most affected.
Arsenic acid	February	..	..	Third most affected.
Arsenic acid	April	..	..	Fourth most affected.
Arsenic acid	June	..	..	} Least affected.
Arsenic acid	July	..	..	
Arsenite of soda	February	..	..	Most affected.
Arsenite of soda	April	..	..	Second most affected.
Arsenite of soda	March	..	..	Third most affected.
Arsenite of soda	January	..	..	Fourth most affected.
Arsenite of soda	July	..	..	} Least affected.
Arsenite of soda	August	..	..	

LIQUID INJECTIONS—1915 SERIES OF EXPERIMENTS.

Specific.	Month Applied.			Degree of Efficiency Attained.
Arsenic acid	January	..	..	Most effective.
Arsenic acid	April	..	..	Second most effective.
Arsenic acid	March	..	..	Third most effective.
Arsenic acid	July	..	..	} Least effective.
Arsenic acid	December	..	..	
Arsenite of soda	January	..	..	Most effective.
Arsenite of soda	February	..	..	Second most effective.
Arsenite of soda	April	..	..	Third most effective.
Arsenite of soda	July	..	..	} Least effective.
Arsenite of soda	August	..	..	
Arsenite of soda	September	..	..	
Arsenious chloride	January	..	..	Most effective.
Arsenious chloride	April	..	..	Second most effective.
Arsenious chloride	March	..	..	Third most effective.
Arsenious chloride	July	..	..	} Least effective.
Arsenious chloride	August	..	..	
Arsenious chloride	September	..	..	
Arsenious chloride	December	..	..	

SPRAYS—1915 SERIES OF EXPERIMENTS.

Specific.	Month Applied.			Degree of Efficiency Attained.
Arsenic acid	January	..	..	Most effective.
Arsenic acid	March	..	..	Second most effective.
Arsenic acid	April	..	..	Third most effective.

All the remainder of these particular plots were ineffectually treated.

VAPOURS—1915 SERIES OF EXPERIMENTS.

Specific.	Month Treated.	Degree of Efficiency Attained.
Arsenious chloride	January	Most effective
Arsenious chloride	November	Second most effective
Arsenious chloride	December	Third most effective
Arsenious chloride	June	} Least effective.
Arsenious chloride	July	
Arsenious chloride	September	

The above figures show that the late summer and early autumn undoubtedly constitute the best seasons during which to tackle the problem of pear-poisoning. December seems to be a rather exceptional month. Taking the series as a whole, it appears to be one of the best months for poisoning pear. The later tables serve to show that its marked efficiency stands only for the injection method of destruction, and that it is an undesirable month to apply sprays or vapours is plainly indicated. Comparison of these tables with those obtained from the similar series of investigations carried on during 1914 shows that in that year December was classed amongst the less desirable months to apply treatment.

The extreme dryness of the atmosphere which existed here during that month in 1915, compared with a fall of 163 points of rain during the corresponding period in 1914, is, in all probability, responsible for this variation.

DETERMINATION OF THE BEST DAY FOR THE APPLICATION OF PEAR POISONS,
WITH REGARD TO THE INTERVAL OF TIME THAT HAS ELAPSED SINCE THE
LAST RAINFALL.

The work of poisoning six pairs of plots was undertaken, with the view of finding out the number of hours which should elapse between rainfall and the application of poison in order to ensure the best results.

The second plot of each pair was, for the purpose of ensuring greater accuracy, simply a duplicate of the first. The specific selected was crude syrupy arsenic acid, which was in some cases injected undiluted into the segments—three grams being allowed per approximate cwt. of living pear plants. In other cases, a solution of 2½ per cent. of crude arsenic acid poison was sprayed on to the plants.

The results furnished by the single series indicate that better poisoning effects are produced on those plants poisoned both by injection and spray methods about, or within, twenty-four hours after heavy rain, while there was little to choose, so far as efficiency of poisoning was concerned, between those poisoned about forty-eight or seventy-two hours after the cessation of heavy rain. The poisoning of these plots was all done under fairly moist atmospheric conditions, the greatest distance recorded between the wet and dry bulb reading at 9 a.m., being 12 degrees F. This was attained on the second day after the rain had ceased.

THE BEST HOUR OF THE DAY FOR THE APPLICATION OF POISONS TO PRICKLY-PEAR PLANTS.

A preliminary series of experiments for the elucidation of this inquiry was performed early last year, as mentioned in my last report.* The experiments consisted in the poisoning of nearly similar plots by similar methods (1) at midday of a day on which the maximum thermometer registered 106.4 degrees F. in the shade; (2) at 8 p.m. of the same day. Up till the date of my last report the plants had reacted on the poison which had been applied during the day to a far greater extent than did those which were poisoned after sundown.

An almost identical series was performed during the present year, the poison being applied at 8.10 a.m., 1.15 p.m., and 8 p.m. Injection and spray methods were both adopted. The poisoning was done on a day on which the maximum temperature reached 84.8 degrees F., and the following results are noted up to date. For both injections and sprays the specific employed was crude arsenic acid. The most satisfactory results were furnished by the plots treated in the middle of the day. The next most efficient results were shown by those poisoned in the morning, while the least effect was visible in those poisoned at 8 p.m. Though the results gained solely from two series of experiments cannot be regarded as in any way conclusive, the coincidence of the results of these two series indicates that the best time to obtain the maximum value of the poison is to apply it during the hot, bright part of the day.

SPECIFICATION OF THE MOST SUITABLE TIME FOR THE APPLICATION OF POISONOUS SPECIFICS TO PLANTS OF DULACCA PRICKLY-PEAR.

The results collected from the various series of experiments performed at this station demonstrate that in order to ensure the most complete destruction of *Dulacca* prickly-pear by poisoning methods the selection of a suitable day is of paramount importance.

Under normal climatic conditions, the best results may be expected from poison administered during the bright part of a day in January, February, or the early part of March, which has been preceded by a heavy fall of rain by about twenty-four hours.

TIME TAKEN FOR THE EFFECTS OF POISONS TO BECOME MANIFEST IN THE PEAR.

For the purpose of the investigation of the different stages passed through by the plants during the process of pear destruction, certain plots were treated each month throughout the poisoning season.

One series of plots was treated after a spell of dry weather of at least seven or eight days' duration. The series was repeated on days immediately following an appreciable fall of rain, or with the intervention of one more or less dry day between the rainfall and the date of treatment. The plants were carefully inspected on the day after poisoning, and subsequently on alternate days for several weeks. Any

* Reprint of Appendix IV. of Annual Report, Department of Public Lands, for year 1914, page 20.

reaction shown by the plants was attentively noted. The specifics employed during this investigation were crude arsenic acid and a mixture of sodium arsenite and salt of the composition stated in another section.

The quantities of specific injected per approximate cwt. of pear were:—Crude arsenic acid, 3, 2.5, 2.0, 1.5, 1.0, 0.75, 0.5, 0.1, 0.05, 0.01 grams; arsenite of soda and salt, 6.0, 5.0, 4.0, 3.0, 2.0, 1.5, 1.0, 0.2, 0.1, 0.02 grams.

SOLID INJECTIONS.

The first effect noticed in pear plants poisoned by the injection of small quantities of specifics into the interior of the second segment from the top of a branch of a pear plant is the discoloration of the young green segments. These become streaked and blotched, principally in the region of the veins, with irregular areas of a dark brownish-purple colour.

Twelve hours after poisoning.—Under both dry and humid conditions the uncut part of the injected segments are discoloured.

Twelve to twenty-four hours after injection.—The poison has spread into most of those young green segments which are directly connected with the branch on which the injected segment is situated. This is shown by the more or less degree of discoloration of these segments. This condition only applies to such plants which have been injected with over 1.0 gram of crude arsenic acid or 2.0 grams of sodium arsenite and soda per approximate cwt. of pear.

Twenty-four to fifty hours after treatment.—The majority of the young green segments are discoloured, and in the case of those plants poisoned after wet weather the process of rotting has commenced. This latter process is not visible in plants injected after a dry period until ten to eleven days after the injection of the poison. In both cases signs of rotting are only visible in plants injected with over 0.5 grams of crude arsenic acid, or over 3 grams of sodium arsenite and salt, per approximate cwt. of pear. A few scattered young segments, however, usually show evidence of the commencement of rotting in plants injected after wet weather with 0.1 to 0.75 grams of crude arsenic acid and with 0.5 to 3 grams of sodium arsenite and salt per approximate cwt. of pear.

Four days after treatment.—Most of the segments (old and young) exhibit various stages in the process of decomposition in plants poisoned with between 3 to 0.5 grams of crude arsenic acid, and with between 6 and 1 grams of sodium arsenite and salt per approximate cwt. of pear, in plants which had been treated soon after rain. After the same interval of time had elapsed, the majority of the young segments of those plants injected with similar quantities of poison after a dry spell are dried up.

Sixty days following the application of the specific.—All the plants treated, except those into which from 1.5 to 3 grams of crude arsenic acid were injected per approximate cwt. of pear, are well on the road to recovery. Those segments which had been partly or wholly destroyed by the specific are completely obliterated by copious growths of vigorous new segments. Plants which had been injected with 1.5 to 3 grams arsenic acid within a comparatively short time after rain were in different stages of decomposition and collapse.

LIQUID INJECTIONS.

The same specifics were employed for liquid as were used for solid injections. The quantities administered were such as to introduce into the plants the same amount of poison per approximate cwt. of pear as was specified in the paragraph dealing with solid injections.

From thirty-six to forty-eight hours after treatment.—Over 50 per cent. of the green segments exhibit discoloured patches, in plants treated both after a dry period or after heavy rain, in such plants as were poisoned with upwards of 1.0 gram of crude arsenic acid or with upwards of 3 grams of sodium arsenite and salt per approximate cwt. of pear. Only slight effects are apparent in plants which had received smaller doses, and are visible only in those segments directly connected with the branch which bears the originally injected segment.

Forty-eight to ninety hours after treatment.—Most of the segments are more or less discoloured and rotting in plants poisoned after wet weather with as small a quantity as 0.75 grams of crude arsenic acid or 1.5 grams of arsenite of soda and salt per approximate cwt. of pear. The plants treated in a similar manner to the above, only after dry weather, differ in effect from them in that the young segments were observed to be drying instead of rotting.

Twelve days after poisoning.—The decomposing process has extended in those plants previously noted as rotting, and new green shoots are emerging from some of the plants injected with the larger quantities of sodium arsenite and salt soon after rain. Most of the younger segments have dried up in the plants poisoned after a dry spell, and the only signs of rotting visible in them are the preliminary stages in odd young segments in plants injected with 3 grams, 2.5 grams, and 2.0 grams of crude arsenic acid per approximate cwt. of pear.

Thirty-two to thirty-five days after the application of poisons.—In both the dry and wet weather plots the plants treated with 3, 2.5, 2.0, and 1.5 grams of crude arsenic acid per approximate cwt. of pear were rotting and collapsing, while all the other plants have recovered sufficiently to be classed as unappreciably affected.

SPRAYS.

The spray solutions employed were solutions of crude arsenic acid, varying from 1.0 to 2.5 per cent. strength. These were compared with solutions of sodium arsenite and salt in the following proportions:—

4 lb. caustic soda,
10 lb. arsenic trioxide,
15 lb. common salt,

brought to 100 gallons by the addition of water.

The sprays applied just after rain have been infinitely more effectual than have those applied during a dry spell; in fact, the results obtained in this latter case are so far inferior to the others as hardly to merit

consideration. Typical plots were sprayed with arsenic acid solution on 29th February after a heavy fall of rain. The plots were $\frac{1}{8}$ -acre in size, and one was sprayed with 2 per cent., and another with 2.5 per cent. solution of crude arsenic acid.

Twenty hours after application.—Practically all the young green segments are discoloured and exhibiting the initial stages of rotting. Each day the rotting process becomes more apparent, and one week after the poison was applied the whole of each plant is in varying stages of decomposition.

One week later.—The main branches have partially collapsed.

Five weeks after treatment.—The plants form decomposing masses lying flat on the ground.

One week later.—A few sprouts have made their appearance from nodes on some of the segments which still retain a portion of their vitality. At the present time some of these newly-developed segments are becoming corky and sickly in appearance, while others appear to be perfectly healthy, and so far exhibit vigorous growth.

The stages observed after the application of crude arsenic acid spray in dry weather correspond for a short time with the above. The rotting process, however, becomes speedily checked, never extending to any extent beyond the soft young segments. These young segments rot, dry, and fall off from the plants.

Now, the plants do not appear to be much the worse for the poison, for vigorous new growth is taking place from the older and apparently uninjured segments.

Different effects are produced in plants poisoned by spraying with sodium arsenite and salt. Two plots of about $\frac{1}{16}$ -acre each, and containing as nearly as possible similar plants of pear, were sprayed, one with a solution of 2 per cent. crude arsenic acid, the other with sodium arsenite and salt solution. The mode of action of the poisons was carefully studied. The segments of the sodium arsenite sprayed plants, instead of becoming discoloured, showed depressions of a lightish colour, which increased and united until the young segments were dry and bleached and were thrown off by the plants.

Every plant thus treated showed vigorous new growth within six weeks from the application of the poisons.

THE EFFECTS OF THE ADMINISTRATION OF POISONOUS SPECIFICS ON THE REPRODUCTION OF DULACCA PEAR, ADJACENT VEGETATION, AND THE SOIL IN WHICH THE PLANTS GROW.

1.—EFFECT ON THE DEVELOPMENT OF FLOWERS OF DULACCA PEAR SUBSEQUENT TO THE POISONING OF THE PLANTS.

No plants were considered which had been subjected to the action of poison after September, 1915.

Plants poisoned between 1st January and September, 1915.—Out of twenty plots containing on an average two or three plants each, and injected with undiluted arsenic acid in the proportion of 3 grams per approximate cwt. of pear, only three plants produced any flowers. One plant had two, another five, and the third had eleven flowers.

Consideration of a similar series of plots treated by the method of liquid injection, the poison being administered in the same proportions as when the undiluted poison was used, showed that blossoms were produced by only one plant, which had four flowers.

A larger number of blossoms were produced by the plants which had been subjected to the action of the poison in the form of spray, of which 0.5 gallons of 2.5 per cent. solution of crude arsenic acid was allowed per approximate cwt. of pear.

Out of about sixty plants eleven had well-developed flowers, of which one plant had an almost normal number, and another plant twenty-four flowers. The largest number of blossoms developed on the nine other plants mentioned was ten.

No flowers were exhibited by plants which had been sprayed with either crude arsenic acid or arsenic trichloride by means of the atomiser spray.

Plants poisoned during 1914.—The majority of the plants which had not suffered sufficiently severely from poisons administered during the early part of 1914 to prevent the production of a fresh vigorous growth of new green segments, produced fair supplies of flowers during the second flowering season after poisoning. The production of flowers by these plants during the first season after poisoning had been very materially inhibited or totally suppressed. None of these, however, developed the normal number of flowers during the second season.

Plants poisoned during 1913.—The third flowering season after poisoning the average number of blossoms was produced in plants which had been poisoned early in 1913, and were in consequence so seriously damaged as to totally suppress the production of flowers in the first season after treatment.

Thus it seems that in those instances in which plants which have been severely damaged, but not killed outright, by the administration of poisonous substances, and in which the development of flowers had been completely checked during the first season after treatment, resume their normal functions, in so far as the production of sexual organs is concerned, in about the third flowering season after the application of the poison.

2.—EFFECT ON THE YOUNG SHOOTS DEVELOPED SUBSEQUENTLY TO THE ADMINISTRATION OF POISONS.

This subject has been already discussed in a previous report.* Later researches have confirmed the statement previously put forward, that even in plants which are apparently lifeless and partially collapsed,

* Reprint of Appendix IV. of Annual Report of Department of Public Lands for the years 1912 and 1913, page 37.

but still manage to retain sufficient vitality to put out new segments, the bulk of these segments do not die, but thrive and serve to continue the life of the plant. The first formed segments, *i.e.*, those produced by the segments which were actually subjected to the action of the poisons, are, as a rule, somewhat stunted, thickened, and have a more or less corky surface, and an unhealthy appearance. The segments which spring from these exhibit less marked evidence of the treatment to which the older segments were subjected, and so on in regular progression till the fourth or fifth formed segments in succession appear to be quite normal and healthy, and together form a healthy green plant.

There are, however, distinct exceptions to this rule, but according to observations made here, which have extended well over three years, the exceptions are constituted by those segments produced subsequently to poisoning, which ultimately dry up and die, rather than by those which thrive and remain healthy and green.

3.—EFFECT ON SEEDS AND SEEDLINGS DISPERSED AMONG THE POISONED PLANTS.

Dilute arsenic acid solution applied as spray has the effect of destroying all the young seedlings which are not protected by the main plants sufficiently to prevent the spray from reaching them. The poisoning of the plants, however, does not appear to exert any deleterious action on the seeds lying scattered on the soil. The majority of these apparently germinate in the ordinary way. The hardness of the lignified tissue forming the seed coat is apparently responsible for the non-penetration of the poison into the seed to any extent, in spite of the fact that lignified tissue is more or less permeable to water. Experiments dealing with the germination of pear seeds have not furnished results of any value, owing to the difficulty of bringing about the germination of the seeds under observation.

4.—THE EFFECT ON SPECIES OF PEAR DIFFERENT FROM THE DULACCA PEAR.

Owing to lack of time, it has not been possible to carry out this investigation.

5.—THE EFFECT ON ADJACENT VEGETATION.

No definite instance has been observed in which surrounding and adjacent vegetation, such as grass and herbaceous weeds, have been completely killed by the poison sprayed on to the pear. Experiments done here indicate that the application of poison to the pear clumps causes the withering of the grass, &c., which grows amongst it. The advent of rain within two or three weeks after the administration of the specific to the pear is usually quickly followed by the reappearance of these herbaceous plants, which grow unhindered amongst the dead or rotting branches of pear.

6.—EFFECT ON THE SOIL IN WHICH PEAR PLANTS GROW.

Plots were prepared for the purpose of determining the extent of deterioration of the soil for agricultural or pastoral purposes owing to poisons sprayed on to the pear plants.

Two sets of plots described in my last report,* including some which were sprayed with crude arsenic acid solution, and subsequently were burnt or dug in, and others, from which the pear was cleared off without having been poisoned, were, at the beginning of April, 1915, sown with (a) wheat; (b) lucerne. The number of seeds which germinated in the differently treated plots are enumerated in the following table:—

PLOTS SOWN WITH WHEAT.

Percentage Number of Seeds which Germinated in the following Plots.		In Plots in which the Pear was poisoned and burnt, and the ash dug in.	In Plots in which the poisoned Pear was dug in without burning.	In Plots from which the Pear was removed without poisoning.
Over 25%	.. ..	In 5 plots ..	In 2 plots ..	In 0 plot
Between 20% and 25%	.. ..	In 0 plot ..	In 2 plots ..	In 2 plots
Between 20% and 15%	.. ..	In 1 plot ..	In 0 plot ..	In 1 plot
Between 15 % and 10%	.. ..	In 1 plot ..	In 0 plot ..	In 2 plots
Less than 10%	.. ..	In 2 plots ..	In 5 plots ..	In 4 plots

The season was a bad one for such observations as these, owing to the small amount of rain which fell here. Consequently, the number of seeds which germinated was small. The greatest number of wheat seedlings produced from about 140 seeds was 61, and these germinated in a plot from which the pear had been sprayed with a 10 per cent. solution of crude arsenic acid, the dried residue had been then burnt with brushwood, and the ash dug into the soil before the sowing of the seeds.

The first flowers were observed on the wheat plants at the end of June, and on 30th July, 1915, stalks of over 4 feet high, with large well-developed ears, were gathered.

The plots which produced the best wheat crops were those which had been poisoned and afterwards burnt and dug into the soil. The four best crops of all were in plots which had been subjected to this mode of treatment. In two of these the pear had been sprayed with arsenic acid solution, and in two it had been subjected to the fumes of arsenic trichloride gas. The poorest crops were gathered from those plots in which the pear had been poisoned and dug into the soil without burning, though there was little to choose between these and those produced by the plots from which the unpoisoned pear had been cleared. Both of these were markedly of inferior development compared with the plots which were burnt. On 1st July some of the aerial parts of each wheat crop were cut, and carefully cleaned by brushing off adherent soil particles. Each sheaf from a plot was weighed and then adequately isolated from any of the others, the sheaves from the same plot being finally bound together. The bundles of sheaves were forwarded for analysis to the Government Analyst, Brisbane, in order to ascertain whether any arsenic in any form had been absorbed into the plants.

* Reprint of Appendix IV. of Annual Report of Department of Public Lands for the year 1914, pages 37 and 38.

The following is the table supplied by the Government Analyst:—

LOTS SOWN WITH WHEAT.

Sample Mark.	Plot.	Weight Taken.	Arsenic Found.	Calculated to Parts Per Million.
AsCl ₃ Gas	2236	Grams. 15	Milligrams.	Arsenic Trioxide.
Unpoisoned pear	2240	15.5	Nil	Nil
	2232	1.1	.. ..	..
AsCl ₃ Gas	2235	5.0	..	..
Poisoned pear dug into soil ..	2239	8.7	..	..
	2231	23.5	Less than 0.003	Less than 0.1
As ₂ O ₃ Injection	2164	1.5	..	..
Poisoned pear dug into soil ..	2162	59.0	Nil	Nil
	2168	3.2	.. ..	..
As ₂ O ₃ Spray	2173	1.8	..	..
Poisoned pear dug into soil ..	2176	0.15	Nil	Nil
As ₂ O ₃ Spray	2171	14	..	..
Unpoisoned pear	2174	60	Less than 0.003	Less than 0.04
As ₂ O ₃ Spray	2169	26	..	..
Poisoned pear burnt and ash dug in	2172	16.5	..	..
	2175	8.2	Less than 0.002	Less than 0.04
As ₂ O ₃ Injection	2163	113.7	..	..
Poisoned pear burnt and ash dug in	2160	87	..	..
	2160	1.8	Less than 0.008	Less than 0.1
As ₂ O ₃ Injection	2161	5	..	..
Unpoisoned pear	2165	53	0.01	0.15
	2167	9	.. ..	..
AsCl ₃ Gas	2230	62	..	..
Poisoned pear burnt and ash dug in	2234	35	Nil	Nil
	2237	93	Less than 0.002	Less than 0.02

As Cl₃ means arsenic trichloride.

As₂O₃ means arsenic acid.

As₂O₃ means arsenic trioxide (white or grey arsenic).

In connection with his report, the Analyst also remarks:—"With reference to enclosed certificate, the actual quantities (not only proportions) of arsenic found, were so extremely minute that they may be regarded as adventitious. The largest amount found in one sample is only $\frac{1}{100}$ milligram, and with so much arsenic about on the station, it

would not be a fair assumption that the minute quantity found had been absorbed from the soil. The results, while not definitely establishing a negative, show clearly that there is no trouble likely to arise through absorption of arsenic under any of the conditions tried."

PLOTS SOWN WITH LUCERNE.

Percentage Number of Seeds which germinated in the following Plots.	Plots in which the Pear was poisoned and burnt, and the ash dug in.	Plots in which the poisoned Pear was dug in without burning.	Plots from which the Pear was removed without poisoning.
Over 100 seeds germinated ..	In 2 plots ..	In 1 plot ..	In 1 plot
Between 90 and 100 seeds germinated	In 0 plot ..	In 1 plot ..	In 0 plot
Between 80 and 90 seeds germinated	In 1 plot ..	In 0 plot ..	In 0 plot
Between 70 and 80 seeds germinated	In 1 plot ..	In 0 plot ..	In 0 plot
Between 50 and 70 seeds germinated	In 0 plot ..	In 1 plot ..	In 1 plot
Between 40 and 50 seeds germinated	In 0 plot ..	In 0 plot ..	In 1 plot
Less than 40 seeds germinated	In 4 plots ..	In 6 plots ..	In 6 plots

As in the case of wheat, the proportion of lucerne seeds which germinated was small. As in the case of wheat also, the most successful crops were those produced in the plots in which the ash from the poisoned and subsequently burnt pear was dug into the soil. Out of the six best crops, three were produced in plots treated thus. There is not much to choose between the number of seeds which germinated in the plots prepared by the other two methods.

In no instance were the crops so well developed as were the wheat crops, and none of the plants advanced far enough to develop flower-buds. The largest number of seedlings produced was 162, in one of the plots from which the pear had been removed without poisoning. The

quantity of seed sown in each plot was 3 grams, which includes between 1,600 and 1,650 seeds. The plants growing in the above plot also attained the highest degree of development.

The lucerne crops were harvested on 8th July, and exactly the same method of procedure was followed as in the case of the wheat crops.

The Government Analyst's report is inserted here.

PLOTS SOWN WITH LUCERNE.					
Sample.	Mark.	Plot.	Weight.	Milligrams As_2O_3 recovered.	Parts per Million as As_2O_3 .
As_2O_5	..	2182 2185	Grams. 32.5 16.1	0.015	0.18
AsCl_3	..	2243 2249	12.0 1.5		
As_2O_5	..	2190	24.5		
As_2O_5	..	2192 2187	3.3 5.6	0.02	0.3
AsCl_3	..	2250 2247 2242	0.3 1.6 13.7		
As_2O_5	..	2180 2181 2184	31.5 1.6 10.8		
AsCl_3	..	2248 2244 2251	0.8 13.0 0.06	0.01	0.3
As_2O_5	..	2186 2183	11.6 8.1		
As_2O_3	..	2191	0.3		

"B"—Poisoned pear burnt and ash dug in. "D"—Poisoned pear dug in without burning.

"N"—Pear cleared without poisoning.

The samples combined as above gave in each instance a minute trace of arsenic.

On 2nd June, 1915, potato tubers were planted in a third series of plots. Thirty pounds of seed potatoes were cut and planted in the prepared plots. Ten pieces of tuber containing "eyes" were put into

each plot, and the plants produced were counted at the beginning of October. The percentage number of plants produced in the different plots was as follows:—

LOTS IN WHICH POTATO TUBERS WERE PLANTED.

Percentage of Plants Produced.		In Plants in which Poisoned Pear burnt and ash dug in.		In Plants in which Poisoned Pear dug in without burning.		In Plants in which Pear removed without poisoning.	
100%	..	In 0 plot	.. ..	In 0 plot	..	In 1 plot	
90%	..	In 1 plot	.. ..	In 1 plot	..	In 1 plot	
80%	..	In 2 plots	.. ..	In 1 plot	..	In 0 plot	
70%	..	In 2 plots	.. ..	In 3 plots	..	In 0 plot	
60%	..	In 1 plot	.. ..	In 1 plot	..	In 2 plots	
50%	..	In 0 plot	.. ..	In 0 plot	..	In 2 plots	
Less than 50%	..	In 3 plots	.. ..	In 3 plots	..	In 3 plots	

Almost as soon as the above was noted, all the plants became dried up and killed off by the drought, so that it was not possible to forward the aerial parts for the detection of arsenic to the Government Analyst.

After heavy rain, three additional series of plots were sown with agricultural seeds on 25th August, 1915.

The seeds sown were—

- 1.—Maize—20 seeds in each plot.
- 2.—Rock Melons (Emerald Green)—15 seeds in each plot.
- 3.—Vegetable Marrows (Long White Running)—9 seeds in each plot.

The majority of these seeds germinated, but the seedlings were destroyed in their very early stages through lack of later rains, thus rendering any further investigations impossible.

ESTIMATION OF THE EXPENSE INVOLVED IN THE POISONING OF PRICKLY-PEAR INFESTED AREAS.

In another section of this report, the difficulty of obtaining arsenic acid during the present crisis was discussed. I had hoped, in this my final report, to be able to state definitely the minimum cost of the most effective pear poison.

The constant fluctuations and enormous increase in the price of arsenic since the outbreak of the war have rendered this impossible. However, the average time taken for the process of applying the poison has been carefully noted, and is expressed in this section.

TIME TAKEN FOR THE INJECTION OF DULACCA PEAR.

The area selected for this investigation was not really a suitable one for injection, the pear clumps being too dense. Consequently, many plants were missed and remain upright and green owing to the difficulty of recognising the separate plants when growing in clumps.

Plate 7 shows a portion of the selected area before treatment, and it will be readily seen that it is more suitable for treatment by the spray pump than by the injector. The area measured half an acre, the weight of pear growing in it being estimated as approximately 378 cwt. or 18.5 tons. The work of injecting this plot was performed by two men, the time taken being seven hours. The injection was done by means of a sharp knife, and spoon of measured capacity. Estimating the price of labour as 1s. per hour, the cost of the labour involved in injecting the pear once on 1 acre of this country would be £1 8s. The quantity of poison used was 7.5 lb. per acre, which allowed 4.5 grams per approximate cwt. of pear.

Labour, per acre, £1 8s.

Quantity of poison per acre, 7.5 lb.

To produce anything like satisfactory results, this plot would require to be inspected and poisoned once or twice again, when the effects of the first applications have become manifest, and the plants which have been missed may be readily distinguished from the poisoned ones.



PLATE 7.—Portion of large plot before it was injected with arsenic acid.

Under favourable weather conditions, by the method of injection, every particle of poison is utilised and none wasted. In this fact lies the greatest advantage of the injection method. It requires the smallest quantity of poison of any of the modes, and for scattered pear plants, or those which are distinctly separated from each other, it is the surest, most economical, and in every respect the most satisfactory method of poisoning.

SPRAYING.

The labour involved in spraying and slashing, and the minimum quantity of poison necessary, were estimated in plots T3, Z, and A1.

Plot Z.—This plot was sprayed by two men by means of the Kirby Uneeda spraying pump. The area of the plot was $\frac{1}{16}$ -acre, and contained approximately 37.25 cwt. of old corky pear in dense clumps. The specific employed was a 2 per cent. solution of syrupy crude arsenic acid. Half a gallon of this spray was allowed per approximate cwt. of pear, so that 18.6 gallons were sprayed on to the whole plot, which represents nearly $3\frac{3}{4}$ lb. of the crude arsenic acid. It took one hour to complete the work. This represents the labour of one man for 32 hours to an acre, containing approximately 29.5 tons of pear.

Labour per acre, £1 12s.

Poison, 60 lb. crude arsenic acid per acre.

Approximate weight of pear per acre, 596 cwt. or 29.5 tons.

Plot A1.—This plot was sprayed with the Kirby Uneeda pump, operated by one man. The area of the plot was $\frac{1}{16}$ -acre, and it contained approximately 27.5 cwt. of old corky pear clumps. It was sprayed with a 2 per cent. solution of crude syrupy arsenic acid, 13.75 gallons of solution being sprayed on to the whole plot. The time taken to complete the work was 54 minutes. Thus it would take one man 14 hours 24 minutes to spray 1 acre of this country—i.e., to poison approximately 440 cwt. or 22 tons of pear.

Cost of labour per acre, 14s. 6d.

Amount of poison per acre, 43 lb. $13\frac{1}{3}$ oz.

Approximate weight of pear per acre, 440 cwt. or 22 tons.

Comparison of these two plots demonstrates that it is superfluous for two men to use the Kirby Uneeda spray pump.

Plot T3.—This was sprayed with the arsenite of soda and salt solution. The method adopted was the well-known one of spraying, slashing, and re-spraying. The Kirby pump was not used for this plot, but the liquid was pumped directly from the water cart described in a previous section. This method renders the services of two men essential. The area of this plot was half an acre, and contained about 312 cwt. of old corky pear. The first spraying occupied 4 hours and 40 minutes. The slashing took 4 hours and 50 minutes, the second spraying 4 hours and 30 minutes. Two men were employed all the time, and thus the whole work represented one man working for 28 hours, or 56 hours on an acre of this country. The total quantity of solution used, allowing half-gallon per approximate cwt. of pear ($\frac{1}{4}$ -gallon being allowed for each spraying) was 156 gallons, containing 21 lb. $13\frac{1}{2}$ oz. of arsenite of soda.

Cost of labour per acre, £2 16s.

Amount of poison per acre, 21 lb. $13\frac{1}{2}$ oz.

Approximate cwt. of pear per acre, 624 cwt. or 31.2 tons.

There was no comparison between the effects produced by the arsenic acid and that produced by sodium arsenite and salt solution, the former proving at least twice as efficient as the latter.

Comparison of the cost of labour involved and the quantity of poison used in the treatment of the above three plots:—

Plot.	Cost of Labour per Approximate cwt. of Pear.				Approximate Amount of Poison per Approximate cwt. of Pear.
Z	0·6 penny	..	..	..	1·6 oz. crude arsenic acid
A ₁	0·3 penny	..	..	..	1·6 oz. crude arsenic acid
T ₃	1 penny	..	..	..	0·56 oz. pure arsenite of soda and salt

PLOTS SPRAYED WITH THE ATOMISER SPRAY.

For these plots two types of spray pumps were employed.

1. That designed by the Cactus Estates, Limited.
2. Holder pump—type D.

Plot B1.—This plot was sprayed with the Holder atomiser, operated by one man. The area of the plot was $\frac{1}{16}$ -acre, and the pear treated approximately 31·5 cwt., which was old and corky and scattered in dense clumps. The specific employed was crude arsenic acid, 10·9 oz. being distributed over the whole plot. The work of poisoning occupied three minutes.

Cost of labour per acre, 9½d.

Weight of poison per acre, 10·9 lb. approximate.

Approximate weight of pear per acre, 504 cwt. or 25·2 tons.

Plot C1.—This was sprayed by means of the Holder atomiser. The area of the plot was $\frac{1}{16}$ -acre, containing approximately 37·5 cwt. of pear. The pump was worked by one man, who applied 40·4 oz. of a 25 per cent. solution of crude arsenic acid to the plot. The pear in the plot was old and corky, in large clumps. It took 19 minutes to complete the work.

Cost of labour per acre, 5s.

Approximate weight of poison per acre, 10 lb. 2 oz.

Approximate weight of pear per acre, 600 cwt. or 30 tons.

Plot D1.—This plot was sprayed by means of the Cactus Estates atomiser, operated by one man. The area of the plot was $\frac{1}{16}$ -acre, containing about 77 cwt. of pear. The specific employed was crude arsenic acid, of which 19·25 oz. were used for the whole pear on the plot. The pear was in clumps, the plants being old and corky.

The time taken to atomise the plot was 9 minutes.

Cost of labour per acre, 2s. 6d.

Amount of poison used, 19 lb. 4 oz.

Approximate weight of pear per acre, 1,232 cwt. or 61·6 tons.

Plot E1.—This was sprayed by means of the Cactus Estates atomiser, operated by one man. The area of the plot was approximately $\frac{1}{16}$ -acre, containing about 77 cwt. of old corky pear in clumps. The specific used was arsenic trichloride liquid as supplied by the Cactus Estates, Limited.

The quantity of poison used was 19.25 oz. for the whole plot, $\frac{1}{4}$ -oz. being allowed per approximate cwt. of pear. It took 9 minutes to poison the whole plot.

Cost of labour per acre, 2s. 6d.

Weight of poison used per acre, 19 lb. 4 oz.

Approximate weight of pear per acre, 1,232 cwt. or 61.6 tons.

COMPARISON OF THE COSTS OF POISONING THESE ATOMISED PLOTS.

Plot.	Approximate Cost of Labour per Approximate cwt. of Pear.	Approximate Amount of Poison per Approximate cwt. of Pear.
B ₁	0.018 penny	0.34 oz.
C ₁	0.1 penny	0.28 oz.
D ₁	0.024 penny	0.25 oz.
E ₁	0.024 penny	0.25 oz.

These plots have been too recently treated to allow of a final comparison. The results given in the table are those recorded about three weeks after poisoning. The position of the plots in the table represents the relative efficiency of the work done, the most successfully treated plot being placed first.

Plot.	Area of Plot.	Approximate Weight of Pear in Plot.	Specific Used.	Amount of Specific used per Plot.	Mode of Application of Specific.
C	$\frac{1}{16}$ -acre ..	37.5 cwt. old corky	25% solution arsenic acid	40.4 oz.	Holder Atomiser
B	$\frac{1}{16}$ -acre ..	31.5 cwt. old corky	Undiluted crude ar- senic acid	10.9 oz.	Holder Atomiser
D	$\frac{1}{16}$ -acre ..	77 cwt. old corky	Undiluted crude ar- senic acid	19.25 oz.	Cactus Estates Atomiser
E	$\frac{1}{16}$ -acre ..	77 cwt. old corky	Undiluted arsenic trichloride	19.25 oz.	Cactus Estates Atomiser

It appears that the marked degree of superiority noted in the results shown by the pear poisoned in plot C over that in the other plots is due to the greater bulk of liquid used, owing to its being a 25 per cent. solution instead of the undiluted substance. This superiority has been noticed in every case in which a solution was used instead of the undiluted crude arsenic acid, the same quantity of the crude arsenic acid being applied in each case.

COMPARISON OF ATOMISER SPRAY AND THE GENERALLY USED COARSER SPRAY PUMPS.

Generally speaking, the work done by means of the atomiser pump is more effective and takes less time than that performed by the coarser type of spray pumps. The disadvantage is, however, that the capacity of the atomisers procurable is very limited, and they are only suitable for scattered clumps of pear. In dense pear, where there is little timber, either upright or fallen, the use of the spray cart would be advisable.

COMPOSITION OF ARSENIC ACID.

Arsenic pentoxide (As_2O_5) is in the pure state a dry white powder. It is generally produced by the oxidising of ordinary white arsenic with nitric acid and the subsequent heating to a red heat. Unlike the white arsenic, it is extremely soluble in water. This property is a rather rare one for any of the arsenic compounds, and this reason is largely responsible for its value as a pear-destroyer.

Dissolved in water, it forms arsenic acid, which may be extracted as a white soluble powder. It is, as its name implies, strongly acid, which, considering the acid reaction of the pear itself, should constitute a distinct advantage for pear-destruction over the alkaline arsenite of soda, which is the poisonous specific most generally used for the purpose.

DEGREE OF PURITY OF ARSENIC ACID REQUIRED FOR SUCCESSFUL PEAR-POISONING.

The purer the specific the better is the work done by it. It is, however, not necessary to use the chemically pure arsenic acid for pear destruction.

Very good results have been obtained with the crude syrupy material manufactured in the Commonwealth, and containing on an average 72 per cent. arsenic acid. Some of the chief impurities are nitric acid and ordinary white arsenic, but the presence of these does not seem to reduce the efficacy of the active arsenic acid. Plants sprayed with a 3 per cent. solution of chemically pure arsenic acid exhibit decidedly better results than do those sprayed with corresponding solution of the crude syrupy material. This is apparently due to there being much less active poison in the crude specific, the strength of the solution of the crude specific in general use here, containing 3 per cent. of arsenic acid, will give results almost, if not quite, as satisfactory as when a 3 per cent. solution of the chemically pure material is used. The samples of arsenic acid which have been used for the experiments performed at this station are:—

1. Chemically pure.
2. Arsenic acid made in small quantity by the Government Analyst, Brisbane. The composition of this sample was—
 - Arsenic pentoxide, 91.6 per cent.
 - Arsenic trioxide, 5.7 per cent.
 - Iron, alumina, water, &c. (by difference), 2.7 per cent.
3. Reserve crude material supplied by the Victor Leggo Co., Victoria—
 - Arsenic acid, 65 per cent.
 - White arsenic, 3 per cent.
4. Crude syrupy material manufactured by Victor Leggo Co.—
First consignment—

The specific consisted of a thick paste and syrup.

The paste contained 74 per cent. arsenic acid.

The syrup contained 70.8 per cent. arsenic acid.

Second consignment—

Contained 53.3 per cent. arsenic acid

Contained 1.5 per cent. nitric acid.

5. A small quantity made by Mr. L. Bagster, University of Queensland. The sample contained—

About 55 per cent. arsenic acid.

Small quantity of white arsenic.

About 20 per cent. sulphate of soda.

COMPARISON OF THE WORK DONE IN PEAR-DESTRUCTION BETWEEN LEGGO CO.'S SYRUPY ARSENIC ACID AND MR. BAGSTER'S ARSENIC ACID.

Pairs of plots, each pair containing plants as much alike as possible, were poisoned by similar methods, on the same day, and as nearly as possible at the same times with—

1. Victor Leggo Co.'s crude syrupy arsenic acid.
2. L. Bagster's arsenic acid.

A sample containing about 550 grains of crude arsenic acid was forwarded to the station by the Chairman of the Board of Advice on Prickly-pear Destruction. On account of the small quantity of specific supplied, experiments could only be performed on a limited scale. Comparison of the plots poisoned by injection by Leggo's and Bagster's poisons, and also by spray solutions of the two specifics show that, so far as it is possible to judge, there is not much to choose between the two specifics. The method by which Mr. Bagster prepared his poison has not been disclosed to me.

PRICE AND AVAILABILITY OF ARSENIC ACID.

In an unofficial letter, dated 1st April, 1914, the Government Analyst of Queensland states that the price of chemically pure arsenic acid at Merck's is 8d. per lb. as compared with 6d. per lb. for similar white arsenic. This degree of purity has, however, been shown to be unnecessary for pear-destruction.

Since German supplies have been cut off, Mr. Avery, of the Victor Leggo Co., Victoria, stated also in an unofficial letter, dated 8th April, 1915, that under normal conditions the cost of arsenic acid in England is about £24 or £25 a ton. This would probably amount to £32 or £33 a ton landed here in Australia. He also stated that, owing to the cheapness of nitric acid in England, and the facilities they have for obtaining the crude acid, their costs are lower than anything which could be done here, unless the acid were manufactured in such quantities as to justify the erection of a large plant, including sets of recovery towers. At this rate, the price of the commercial arsenic acid would come out at about 2½d. per lb. in England, and about 3½d. per lb. landed in Australia.

Since receiving this letter, I have communicated with several chemical manufacturers in America and England, asking for quotations for their prices of arsenic acid. The replies received are as follow:—

The American firms did not quote at all, as it is not a substance which is manufactured to any extent in the United States.

LONDON MANUFACTURERS.

Hopkins and Williams advise that their works are fully engaged in urgent Government service, and at present they could not undertake its manufacture. They say, also, that any estimate of the present cost could be of no use in judging its availability for permanent use. They state they will be pleased to go into the question again under more settled conditions.

Johnson and Sons.—This firm says it cannot offer arsenic acid to advantage at the present moment.

May and Baker quote the 98 per cent. pure material at £48 10s. a ton—i.e., less than 5½d. per lb.—but the price under present conditions is variable.

From the above statements the impossibility of quoting any definite prices under war conditions will be understood. But they serve to show that under settled circumstances it should be a moderately priced substance.

SUPERIORITY OF ARSENIC ACID OVER ALL OTHER CHEMICAL SPECIFICS WHICH HAVE BEEN EMPLOYED FOR PEAR-DESTRUCTION UP TO THE PRESENT TIME.

For poisoning prickly-pear by either injection or spray methods, there is no doubt that arsenic acid is superior to all other chemical specifics. Apart from the fact that the results furnished by it, as an efficient pear-destroyer, are very much in advance of those furnished by any other specific tried here, it possesses three valuable characteristics.

1. It is soluble in both hot and cold water.
2. While every care must be exercised in the handling of this specific, it is far less likely to prove injurious to an operator than many of the other poisons employed as pear-destroyers.
3. Under normal conditions, it is comparatively cheap.

Summary of information deduced from the results of thousands of experiments performed at the Dulacca Experimental Station, dealing with the destruction of Dulacca pear through the agency of poisonous specifics.

1. *For the injection of undiluted specifics.*—2.5 grams of arsenic acid should be injected per approximate cwt. of pear. The poison should be injected into the second segment from the top of the branch of pear, and about three segments should be injected in each plant. Choose, as nearly as possible, the bright part of a day in January or February, about twenty-four hours to four days after a fall of rain.
2. *For the injection of diluted specifics.*—About 12.5 grams of a 20 per cent. solution of arsenic acid should be injected per approximate cwt. of pear. Proceed in the same way, and choose similar climatic conditions as were specified for undiluted specifics.

3. *For the spraying of solutions.*—A 2.5 per cent. solution of arsenic acid in water should be sprayed over all parts of the plant or clump. Half a gallon of solution should be allowed per approximate cwt. of pear. The spray should be applied during the bright part of a day in January, February, or early in March, as soon as convenient after a fall of rain.
4. *For the spraying of undiluted liquid specific, or of strong solutions of the specifics, by means of the atomiser spray.*—A 25 per cent. solution of arsenic acid should be used, of which about 30 grams should be allowed per approximate cwt. of pear. Choose the bright part of a day in January, February, or the early part of March, as soon as possible after a fall of rain, for the application of the specific.

The application of poisonous specifics to the pear plants, by any of these methods, does not appear to permanently affect in an injurious way the adjacent herbage.

Neither does it appear to exert any deleterious effect on the soil in which the poisoned pear is growing.

WILD COCHINEAL INSECTS AS PRICKLY-PEAR DESTROYERS.

The destruction wrought by the wild cochineal insects from Ceylon (*Coccus indicus*, Green) on plants of *Opuntia monacantha* situated in confined areas in selected localities in North Queensland was discussed in my last report.* Frequently repeated experiments, which will be described later, for the purpose of ascertaining whether the insects could be induced, in the absence of the *Opuntia monacantha* species of pear, to attack parasitically other useful plants, have invariably yielded negative results.

These results eliminate the possible danger of the insects, even though starving, of attacking the common agricultural or pastoral plants growing in Queensland. Consequently, during a visit to some of the Northern parts of Queensland, about the middle of last year, I removed a few of the wild cochineal insects from the hessian erection in which they were bred, and liberated them on some large clumps of *monacantha* pear growing along the banks of Sandy Creek in the Charters Towers district. (See Plate 8.)

A few months later, insects were distributed on clumps of pear in many of the *Opuntia monacantha* infected districts.

I have just returned from a visit of inspection to these districts, and found the results obtained highly satisfactory.

The amount of havoc created by the wild cochineal insects on this species of pear is marvellous, bringing about, in a comparatively very short space of time, the complete destruction of the plants.

Plate 9 represents a photograph, taken this month, of the same clump of pear as is shown in Plate 8, but taken from a slightly different aspect. The insects have passed from one plant to another at an astonishing

* Reprint of Appendix IV. of Annual Report of Department of Public Lands, for the year 1914.

rate, and, according to the Crown Lands Ranger at Charters Towers, who has watched the progress of the insects very closely, they have travelled distances upwards of a quarter of a mile from one pear clump to the next. The cochineal insects have spread for many miles along the banks of Sandy Creek, effecting the destruction of the *Opuntia monacantha* plants growing there. Soon after the plant becomes attacked by the cochineals it becomes yellow and sickly, and a few months later the entire plant has rotted away, only skin and fibre being left.



PLATE 8.—Clump of *Opuntia monacantha* growing at Charters Towers. A few masses of *Coccus indicus* (Green) were thrown into this clump in April, 1915.

Any new shoots which may happen to sprout from some less injured node of the plant are very quickly attacked by the insects, and in their turn perish. Equally good results were noted in Bowen, Townsville, and Charters Towers, and their environment, and wherever the *Coccus indicus* (Green) is present, the *Opuntia monacantha* plants seem to be doomed.

The destruction of *Opuntia monacantha* brought about through the agency of the cochineal insects is the most complete method of destruction of prickly-pear plants which I have ever seen, and before many months have elapsed I fully expect that the *Opuntia monacantha* will be quite eliminated from those districts in which any *Coccus indicus* (Green) insects have been distributed.

DESTRUCTION OF *OPUNTIA MONACANTHA* BY *COCCUS CONFUSUS CAPENSIS*
(GREEN) FROM SOUTH AFRICA.

The travelling Commission on Prickly-pear Destruction whilst in South Africa secured a few of these insects, and forwarded them to me for experiment. The members of the Commission stated that the destruction wrought on *Opuntia monacantha* by these insects is not so complete as that caused by the previously discussed species from Ceylon.†



PLATE 9.—Remains of the same clump of *Opuntia monacantha* as is shown in Plate 8. The photograph was taken in June, 1916, and shows the injury done to the pear by the wild cochineal insects.

† Report of the Prickly Pear Travelling Commission, 1st November, 1912—30th April, 1914 (page 33).

At this station the specimens of both species have been kept absolutely isolated from each other, but both appeared to be equally destructive to the small plants of *Opuntia monacantha* which were raised from cuttings here.

Specimens of both kinds of insects were forwarded to Mr. Wright, the Crown Lands Ranger at Bowen, for the purpose of comparing the efficiencies of both species as pear-destroyers. The experiments were carried out on large *monacantha* pear plants in quite different parts of the town. The destruction achieved by the *Coccus indicus* (Green) was much more rapid and complete than was that achieved by *Coccus confusus capensis*.

For a long time no effect was apparently produced on the pear by the latter species of insect, but just recently the damage caused by the insects has begun to be manifest, and the destruction of the pear plants is proceeding in a slow, but apparently sure, manner.

POSSIBILITY OF THE WILD COCHINEAL INSECTS ATTACKING USEFUL PLANTS.

Further attempts to induce the wild cochineal insects, under stress of starvation or any other cause, to settle and feed parasitically on the common useful plants in Queensland have invariably failed.

The following plants have been proved to be incapable of acting as hosts for the wild cochineal insects:—

Broad beans	Potatoes
Cabbages	Pumpkins
Cucumbers	Radishes
French beans	Rock melons
Grape vines	Sweet potatoes
Green peas	Tomatoes
Lettuce	Turnips
Lucerne	Vegetable marrows
Passion fruit vines	Water melons
Pasture grasses, &c., at Dulacca	Wheat.
Pineapples	

The results furnished by these experiments indicate that there is no danger of the wild cochineal insects subsequently attacking useful plants.

POSSIBILITY OF THE WILD COCHINEAL INSECTS SUBSEQUENTLY ATTACKING OTHER SPECIES OF PRICKLY-PEAR THAN *OPUNTIA MONACANTHA*.

Numerous experiments performed with the object of endeavouring to induce the cochineal insects to attack other species of prickly-pear than *Opuntia monacantha* with the hope of its ultimate destruction have resulted in failure every time.

Some of the selectors and others who have land infested with the species of pear which grows at Dulacca are continuing their efforts in this direction, with the hope of being able ultimately to acclimatise the insects to attack parasitically this class of pear.

POSSIBILITY OF THE EXTERMINATION OF THE WILD COCHINEAL INSECTS BY
PARASITES.

During the year, a letter was received from Mr. Tryon, Government Entomologist of Queensland, informing me that a ladybird (*Cryptolæmus montrouzieri*) was preying on the cochineal insects in the Charters Towers district. During my recent visit to North Queensland numbers of these ladybirds were seen, but the cochineal insects were too numerous for the damage wrought by the ladybirds to be really serious. A second parasitic insect* was also observed, which destroys the cochineal insects, and, according to the Crown Lands Ranger at Charters Towers, also demolishes the ladybird beetles.

The pear destruction by the *Coccus indicus* in the districts in which these two cochineal-destroying parasites are present is progressing with such rapidity, in spite of them, that there will, in all probability, be sufficient cochineal insects left to complete the task of pear destruction.

OCCURRENCE OF THE DULACCA SPECIES OF PEAR IN NORTHERN AND
WESTERN QUEENSLAND.

Unfortunately, the species of pear growing at Dulacca is present in small amount in different localities in Northern and Central Queensland, and it is spreading very rapidly.

I observed it growing in Townsville at Kissing Point, on freehold land and on the Defence Department Reserve. It is also spreading quickly along the banks of Millichester Creek, in the Charters Towers district. Though the plants are young, they have already flowered and produced fruit, and their eradication should be accomplished with much urgency.

This class of pear is very abundant about Blackall; in some parts it is quite impenetrable. And growing as it does amongst the trees and scrub, it is a difficult task to eradicate it.

Much good work in this direction has been accomplished, and is still in progress, by some of the managers of stations which include pear-infested areas in the Blackall district, but their task is a difficult one.

A large area of South-Western Queensland is already over-run with this pear, which I consider it would be impossible to eradicate by any methods at our disposal at the present time.

These isolated patches of pear, such as occur round Charters Towers and Blackall, have not, I think, got beyond the stage at which they could be controlled by poisons, burning, &c., and the question of their destruction is a most important one, and cannot afford to be delayed. Anyone who has seen the pear-infested lands of South-Western Queensland will realise that there is no more pressing problem to-day. Pear which would cost hundreds of pounds to eradicate now would necessitate the expenditure of thousands in a very few years, and Queensland cannot afford to wait.

* Specimens of these were forwarded to the Government Entomologist of Queensland for identification, but so far the name has not been received by me.

About Blackall the leaseholders are endeavouring to grapple with the question, but so far, at Charters Towers, little work has been done towards the destruction of this class of pear, though the chairman of the Shire Council, whom I interviewed during my recent visit, has promised to start the eradication at once.

CONTINUATION OF THE INVESTIGATIONS ON PRICKLY-PEAR DESTRUCTION.

In the establishment of an experimental station for the purpose of determining methods of destroying prickly-pear, and in sending a travelling commission round the world to inquire into methods of eradication in other countries, the Queensland Government has done good work.

As a result, much valuable information has been collected by the members of the travelling commission, who also introduced the two species of cochineal insects to Queensland. These insects show promise of completely clearing off the *Opuntia monacantha* pear from the State. The most effective pear-destroying specific yet known—viz., arsenic acid—has also been determined. The work, however, has only really just commenced, and the problem of pear destruction is a most pressing one regarded from the point of view of the pastoral industry of Australia.

In the badly pear-infested pastoral land the cost of poisoning, even if reduced to the cheapest of specifics and to the minimum amount of labour necessary, is too excessive to render such action possible. In most cases the expense involved by this method of clearing would exceed the present value of such grazing land. The only real solution of the difficulty appears to lie in the possibility of the discovery of some parasitic insects or organisms capable of bringing about the destruction of the different species of prickly-pear as completely as the *Coccus indicus* (Green) has done for the *monacantha* species in North Queensland.

It is the possible discovery of some such parasite which urgently needs investigation now.

Meanwhile the use of poisonous specifics, especially arsenic acid when obtainable, should afford relief to agriculturists and selectors whose land, unfortunately, possesses the pear as an unwelcome tenant. The need for further investigations is imperative on account of the rapidity with which the pest is spreading.

The question of the taking over of the investigations dealing with the eradication of prickly-pear in Australia by the newly-formed Bureau of Science and Industry under the Federal Government is at present under discussion.

Millions of acres of good land are rendered useless in Queensland owing to the prickly-pear pest, and most of the other States are infested to a greater or less degree.

Large tracts of land in New South Wales are monopolised by the pest, and the danger in that State is a grave one.

In parts of Victoria, notably about Melton, South Brighton, and Essendon, a species of pear is quickly gaining a hold.

This species is probably identical with the *Opuntia monacantha* of Northern Queensland, which is rapidly being exterminated there by means of the wild cochineal insects.

The Director of Agriculture in South Australia informs me that he does not consider the pear a pest in that State, though two species are prevalent there—viz., *Opuntia monacantha* and *Opuntia vulgaris*.

The Acting Director of Agriculture of Tasmania states that the pear has not escaped from cultivation there yet.

I am advised that the prickly-pear is found growing in a few isolated spots in Western Australia, but as it is not spreading very rapidly, it is not yet regarded as a pest.

I have also been unofficially informed that a species of pear has run wild on Thursday Island.

From the above, it seems that further consideration of ways and means of eradicating the prickly-pear pest should be a Commonwealth undertaking.

It is a matter of the most pressing importance for Australia, and Australia should not delay.

Whether regarded as a pest or not, in certain States it can only be considered as a dangerous plant which needs stamping out completely in the shortest time possible.

A grave danger is the possibility of the production of hybrids specially suited for flourishing and reproducing in localities in which the existing species have not spread sufficiently, up to the present day, to warrant their being classed as pests.

CONCLUSION.

Shortly before the establishment of this station, in November, 1912, the secretary of the Board of Advice on Prickly-pear Destruction furnished me with three formidable-looking pages, on which was suggested the scope of investigations to be carried out at the Dulacca Experimental Station.

A copy of the list is printed here.

THE PRICKLY-PEAR EXPERIMENTAL STATION.

SCOPE OF INVESTIGATIONS.

A.—THE GROWTH OF THE PLANT.

1. *The Plant*.—The growth of the prickly-pear under different soil, water, meteorological and seasonal conditions, and whether originating in—

(a) seed;

(b) cuttings (including immature fruit);

with especial reference to kinds or varieties concerned and their behaviour in these respects.

2. *Seed Formation*.—The production of flowers, pollination of flowers, production of fruit, production of seed, and factors influencing them.

3. *Seed Germination*.—The influence of the several physical conditions realised in nature on the germination of the seed.

The influence of the ingestion of the seed by animals (stock, birds, &c.) on its germination.

The actions of bodies deleterious to the plant generally on the vitality of its seeds.

4. *Natural Factors Influencing Growth*.—The action of specific organisms (animal or plant) in influencing the growth of the plant or determining it. (Injurious insects and parasitic diseases.)

Physiological diseases of the prickly-pear and their control.

5. *Structure and Composition*.—The composition of the plant, including the consideration of—

(a) its structural elements;

(b) its component substances;

with special inquiry regarding these severally.

B.—THE SUBJUGATION OF THE PLANT.

1. *Poisoning—Fundamental Investigations*.—The nature and exact mode of action of the several toxic bodies, both chemical and physiological, on the plant, used singly or variously combined—

(a) under different methods of exhibition;

(b) under various conditions of the plant arising from season or soil, or any other condition of environment.

The course characterising the development of symptoms of poisoning in the plant and the factors influencing the rate in which they are manifested or propagated.

The influence of non-toxic bodies on the action of the toxic ones with which they may be combined or mixed, including the reaction of constituents of the plant itself.

2. *Application of Poisons*.—The efficiency and rate of action of poisons as influenced by the following factors, amongst others:—

(a) Spraying with and without previous cutting or other mechanical injury;

(b) Injection with respect to the parts of the plant treated.

The consideration of the minimum amounts in which poisons may be efficiently administered to secure identical or comparable results.

3. *Relative Merits and Costs of Poisons*.—The relative value in prickly-pear destruction under rigid test conditions of bodies of definite composition submitted for experimental purposes or forming articles of commerce as compared with any approved standard, including consideration of costs.

C.—MECHANICAL DEVICES.

Mechanical devices and processes for destroying prickly-pear, or as auxiliary to its destruction by poisoning, or as promotive of its uses, and their relative merits under the several circumstances of the growth of that weed.

D.—INCIDENTAL RESULTS FROM TREATMENT.

The relative value of different methods of killing prickly-pear, in preventing the subsequent growth of the weed from seed or plant-fragments on the sites where they have been applied.

Questions relative to injuring man or beast or poisoning soil or water as the issue of methods of treatment of prickly-pear.

E.—DESTRUCTION BY UTILISATION.

The action of the plant (including a consideration of its different parts) on stock of several classes when included in rations of definite composition and in which it forms a component in varying amount.

The influence on arable land of prickly-pear employed as soilage as shown by the condition of economic plants grown thereon or otherwise.

The components of the plant in its relation to arts and manufactures.

F.—GENERAL.

Any other matters for investigation that may from time to time be submitted by the Board of Advice.

Generally, the practical application in prickly-pear destruction of the results issuing from the investigations.

So far as was in my power, I have endeavoured to carry out the investigations suggested, but it has not been possible to undertake the consideration of a few of the sections, for reasons which are stated below:—

PART A.

The results achieved from observations and experiments dealing with the sections included under this heading have been set out in my annual reports.

Time has not allowed for the investigation suggested in the latter half of Section 4.

PART B.

With the exception of the last suggestion under the First Section included in heading "B," no opportunity has been forthcoming for the consideration of this First Section. This investigation was beyond the scope of the equipment and staff of the Dulacca Experimental Station.

PART C.

And the first and last sections of Part E have for the same reason not been inquired into here.

The consideration of the first section under heading "E" has been undertaken by the Department of Agriculture in Queensland.

In concluding this, my fourth and final report, I wish to record my appreciation of the assistance which has been rendered to me by the heads and staffs of the Lands Office in the towns which I have visited in connection with my work. Valuable help has been given to me by the Land Rangers in *Opuntia monacantha* infested localities in distributing the cochineal insects, &c., and I wish to tender my sincere thanks to them, and to the many other institutions, departments, and individuals that have so generously assisted me in this colossal task.

I have, &c.,

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